Small Payloads Provide Worldwide Research Opportunities

Overview

Researchers worldwide will fly experiments on STS-108 through NASA's Shuttle Small Payloads Project (SSPP), managed at the Goddard Space Flight Center, Greenbelt, Md., and its Wallops Flight Facility, Wallops Island, Va. The SSPP designs, develops, tests, integrates and flies a group of carrier systems in the shuttle's cargo bay. These carriers – the Hitchhiker, Complex Autonomous Payload., Get Away Specials and Space Experiment Module – support payloads supplied by NASA, other U.S. government agencies, domestic and foreign commercial customers, foreign governments, and schools from kindergarten through universities. The following small payloads will be flown aboard Endeavour during the STS-108 mission. They will be mounted on the cargo bay sidewall in bay 3 and across bridge systems in bay 4/5 and 13.

Hitchhikers

Hitchhiker payloads fly in canisters or on experiment mounting plates located on a cargo bay sidewall or cross bay-bridge. For STS-108, the Hitchhikers, complex Autonomous Payload and two SEM payloads will fly on a bay 4/5 cross-bay bridge designated MACH-1 (Multiple Application Customized Hitchhiker). The Hitchhiker carrier provides electrical power, command signals, and "downlink" data interfaces. Hitchhiker customers may operate their payloads from the Hitchhiker Control Center at the Goddard Space Flight Center or from a remote site.
Hitchhike web site: http://sspp.gsfc.nasa.gov/hh/index.html

STARSHINE-2 (Student Tracked Atmospheric Research Satellite for Heuristic International Networking Experiment)

Rocky Mountain NASA Space Grant Consortium/Utah State University

STARSHINE-2 is part of an education program for students around the world to help construct a satellite and learn about satellite orbits and natural events that affect these orbits.

The satellite is a hollow, 19-inch (48.26 centimeters) diameter ball, about the size of a large beach ball. The 85-pound (38.8 kilogram) satellite is covered with nearly 900 aluminum mirrors that have been polished by nearly 25,000 students around the world. STARSHINE-2 will be deployed from a Hitchhiker canister and using a cold gas spin system, will rotate at five degrees per second to enhance visibility of the satellite from observers on the ground. The satellite will be deployed late in the mission.

Through the six-month lifetime of the satellite students will be able to track its position, visually observe it at twilight hours, calculate orbits, measure changes in the orbit and observe the effect of solar activity on the orbit.

The satellite is the same size and mass as STARSHINE-1, which was deployed from Discovery during the STS-96 mission in May 1999. A similar STARSHINE also was launched aboard an Athena 1 from Alaska in September 2001.

Principal Investigator: Professor R. Gilbert Moore, Utah State University
Web site: http://www.azinet.com/starshine

Capillary Pumped Loop Experiment (CAPL-3)

NASA Goddard Space Flight Center/Naval Research Laboratory/Swales Corp.
Capillary Pumped Loops are two-phase heat transfer devices that use capillary forces for heat acquisition and fluid pumping with no moving parts. A single system can cool multiple components and reject heat to multiple radiators. The system can transfer high heat loads over long distances with reliable, vibration free operation and passive control. The system design provides versatility and lower weight over heat pipe systems with same transport requirements. It uses heat load sharing. It can automatically use waste heat from operating components to warm non-operational components.

CAPL-3 is a follow on to CAPL-1 on STS-60 and CAPL-2 on STS-69. The main objective of CAPL-3 is to demonstrate in space a multiple evaporator capillary pumped loop system, capable of reliable start-up, reliable continuous operation and at least 50% heat load sharing with hardware for a deployable radiator. CAPL-3 is a two-phase ammonia thermal control system consisting of a capillary pumped loop with multiple capillary evaporators and parallel direct condensation radiators. There are provisions in the evaporators to improve liquid/gas management and increase the system reliability over CAPLs 1 and 2. CAPL-3 also will demonstrate heat load sharing between evaporators.
Experiment Manager – Laura Ottenstein, GSFC

Prototype Synchrotron Radiation Detector (PSRD)

ETH Zurich, RWTH Aachen and MIT Cambridge
The PSRD is a test of instrumentation that is part of a future International Space Station (ISS) experiment. The PSRD payload is a part of the NASA/Department of Energy Alpha Magnetic Spectrometer (AMS) program. The PSRD flight will test and simulate the Synchrotron Radiation Detector (SRD) technology in the space environment similar to conditions that AMS will experience in its three-year mission on the ISS. The PSRD will provide the crucial on orbit background measurements for the SRD on AMS. The goal of AMS is to perform accurate, high statistic measurements of charged Cosmic Rays up to the highest energies. The 206-pound PSRD includes an x-ray detector, scintillator telescope, solar cells, and two computers.
Principal Investigator: Gert Viertel
Web site: http://psrd.home.cern.ch/psrd/

Complex Autonomous Payload (CAP) (1)

The Complex Autonomous Payload carrier provides limited mechanical and electrical interfaces for self-contained experiments. Simple crew control functions may be performed, but the user addresses internal system requirements. The carrier is a 5 cubic foot canister and the experiment weight limit is 200 pounds. CAP payloads are secondary payloads, while GAS at tertiary payloads.

Collisions into Dust Experiment (COLLIDE-2)

NASA Glenn Research Center/University of Colorado

COLLIDE-2 is an investigation into planetary dust rings. A follow on to COLLIDE-1, which flew on STS-90, COLLIDE-2 performs low-velocity impact experiments into simulated dusty regoliths in microgravity. These impacts simulate the conditions in planetary rings and early protoplanetary disks. The experiment will give scientists a look at the dynamics, origin and evolution of planetary ring systems. Rings are collisionally evolved systems. Collisions sculpt the ring, leading to spreading, transfer of angular momentum, release of dust particles and damping of waves and wakes. The rate of evolution depends on dissipation of energy in collisions. COLLIDE-2 results also can be applied to the lifecycles of planetary dust rings.
Principal Investigator: Joshua Colwell, University of Colorado
Project Manager: Monica Hoffmann, NASA Glenn Research Center
Web site: http://lasp.colorado.edu/collide

Get Away Special (GAS)

The Get Away Special carrier provides limited mechanical and electrical interfaces for self-contained experiments. Simple crew control functions may be performed, but the user addresses internal system requirements. Five of the GAS carriers flown are five cubic foot canisters and one is a 2.5 cubic foot canister. The customer equipment can weight up to 200 pounds (91.32 kilograms) in the larger canister and 100 pounds in the smaller one.

G-730. g-064 and G-785 are located on the Lightweight MPESS Carrier (LMC), a new keeless bay 13 cross-bay bridge developed the NASA Marshall Space Flight Center. The LMC provides accommodations in previously underutilized locations in bay 13.
Get Away Special web site: http://www.wff.nasa.gov/gas
LMC web site: http://flightprojects.msfc.nasa.gov/fd23_paycar.html

G-761

Argentine Experiments Package (Paquete Argentino de Experimentos – PADE)

The Argentine Association of Space Technology is flying seven experiments designed by personnel at Argentine universities and scientific institutions.

1. Transport Fluids in Non-Circular Tubing
   Researchers are interested in studying the flow of fluids in microgravity through various geometric shaped tubes to determine the most efficient way to transport fluids in space. For this experiment, several channels of different sections (triangular, round, hexagonal and others) will be filled colored water. Scientists will measure the velocity of fluid in each channel.
2. Surface Vibration of Water Drops
   Scientists will measure the surface vibration generated by surface tension in water drops in microgravity. Similar tests on Earth are influenced by gravity. The results may have applications in the petrochemical industry as well as space applications.
3. Migration of Drops and Bubbles in Micro Gravity
   Scientist will study the convection of water drops and bubbles in microgravity to determine the feasibility for future development of a detector of drop and bubble movement based on thermal changes.
4. Exposure of Seeds to Space
   This experiment is designed to examine cell mutation and modifications in several types of seeds exposed to the space environment. The retrieved samples will be compared with samples maintained on Earth. The experiment will be used to interest Argentine high school students in biological experiments.
5. Crystal Formation and Growth in a Micro Gravity Environment
   The objective of this experiment is to determine the differences in crystal growth between Earth and space. The results are applicable to the pharmaceutical and electronics industry, since some day the manufacture of high quality crystals can be made in space.
6. Maximum Accelerations Register
   To aid in the development of an acceleration recorder that does not require electrical energy, the experiment will record maximum acceleration of the orbiter during flight. The experiment consists of two system to record acceleration: a mechanical device which turns springs and a device activated by the change of shape of strings from one stable equilibrium position to another.
7. Geophysical Fluids Movement
   A common goal of the sciences of meteorology and oceanography is the simulation of atmospheric and sea movement in spherical bodies. On Earth, achieving this is impossible due to the presence of gravity. In micro gravity, it is possible to simulate this behavior. To achieve this goal, researchers must establish simulations that permit them, by analogies, to associate movements to those in oceans and atmosphere simulating a small "planet" inside the container.

Payload Manager: Pablo De León
PADE web site: http://www.aate.org/g761.htm

G-775

Microgravity Smoldering Combustion (MSC)
NASA Glenn Research Center

Overview

Smoldering combustion is a complex, nonflaming form of burning that occurs in the interior of porous, combustible materials such as piles of leaves or pine needles, furniture stuffing, and cable insulation. Smolder is a serious problem: 40% of all deaths caused by fire in the U.S. can be attributed to the smoldering of household furniture, which releases toxic byproducts. Smolder is potentially an even greater problem in space.

The Microgravity Smoldering Combustion experiments are conducted in microgravity and in normal gravity. The microgravity setting is especially valuable because it permits scientists to study smoldering combustion mechanisms without the complications introduced by gravity and it gives them insight into the differences between how smoldering combustion behaves on Earth and in space.

The experiment consists, essentially, of heat, fuel, and air. The hardware includes a cylindrical sample holder, whose major parts are a flow inlet for the introduction of air; an igniter to start the smoldering process; thermocouples to measure temperature and determine speed; and polyurethane foam which functions as the fuel. The sample holder is placed inside a sealed combustion chamber, which in turn is placed in the MSC flight assembly (which holds two combustion chambers). This assembly, which is placed inside the Get Away Special Canister in the cargo bay of the Space Shuttle, includes an ultrasonic imaging system similar to those found in medical clinics and hospitals. This imaging system can “see” into the foam to measure the extent of smolder.

Smoldering combustion is usually divided into opposed flow, forward flow, and quiescent (still air) configurations. In opposed flow, the air mixture enters the reaction zone (where the temperature is hottest) from the opposite direction in which the smoldering combustion is moving through the polyurethane; in forward flow, air enters the cylinder from the same direction in which the smoldering combustion is traveling. In the quiescent setting, no forced air is introduced.

During STS-108, forward flow and quiescent configurations will be tested. The airflow rate will be 5 mm/second (approximately the speed of airflow produced by a space facility’s environmental control system); the oxidizer will be air (with a higher concentration for the quiescent test); and each test will last almost two hours.

History/Background

An early version of the MSC experiment flew on USML-1 in 1992. The present version was first tested on Earth and flown aboard STS-69 (1995) and STS-77 (1996) and investigated smoldering combustion in quiescent and opposed airflow settings. In the opposed flow configuration in microgravity the smoldering combustion moved along the entire length of polyurethane foam; during the quiescent tests, however, no movement was observed beyond the influence of the igniter. It is believed that the cylinder that encases the foam prevented an adequate amount of oxygen from reaching the reaction zone. Consequently, the cylinder will not be used in the quiescent test on STS-108 and scientists expect that the smolder will move across the sample.

The experiment also was flown on STS-105 (2001), during which forward flow and opposed flow tests were conducted.

Benefits

By increasing our fundamental understanding of smoldering combustion, the MSC experiment will improve our ability to predict and prevent smolder-originated fires on Earth and in space.

Principal Investigator: Prof. A. Carlos Fernandez-Pello, University of California-Berkeley
Project Scientist: Dr. David Urban, NASA Glenn Research Center, Cleveland, Ohio
Project Manager: Frank Vergilli, NASA Glenn Research Center
Web site: http://microgravity.grc.nasa.gov/combustion/index.htm#top.

G-221

Utah State University

Three high schools from Utah and Idaho designed and built experiments. Utah State University sponsored the GAS container and provided assistance to the students. G-221 also contains popcorn that will be used in science outreach programs by the University with local elementary school students.

Nucleic Boiling

We all know that when water boils, the bubbles go up. In space, because of the lack gravity, there is no up. So, where do the bubbles go? That is the question this experiment is trying to answer. The experiment boils water inside a chamber and videotapes the action of the bubbles. Small thermometers placed in different locations in the chamber record the temperature. The collected data will allow students at Box Elder High School, Brigham City, Utah, to see how the bubbles move in the chamber while it is being heated.

Chemical Unit Process

If you are on a long journey in space, all you have are the things you brought with you. That includes water. In order for the water to continue to useful, a method of purifying the water needs to be developed for space applications. This experiment takes a solution of urea (a major component of urine) and purifies it through a process developed by students Shoshone Bannock Jr./Sr. High School, Ft. Hall, Idaho, with the help of engineers at INEEL. Once the experiment returns, the students will analyze the water to identify any contamination.

Crystal Growth

Surprisingly enough, some crystals form differently in the micro-gravity of space than they do on Earth. This experiment is going to grow crystals from chemicals commonly found in the human body. During long duration space flight it will be important to know how these crystals form differently in space. The results will be examined by students from Moscow High School, Moscow, Idaho.

Popcorn and Seeds
Elementary school students will be given a package of Earth-bound microwave and a package that flies on G-221. The students will determine which bag went to space. The students will characterize the two samples after popping. Each group will decide what properties of the popcorn to measure.

Principal Investigator: Jan Sojka
Web site: http://gas.physics.usu.edu

G-730

Weak Convection Influencing Radial Segregation
Swedish Space Corporation

Scientific Objective
The electrical properties of a semiconductor are strongly influenced by the addition of small amounts of a so-called dopant and its spatial distribution within the semiconductor crystal. Especially, the radial homogeneity of the dopant distribution in the bulk crystal is of extreme importance for its commercial application as material for the production of chips for electronic circuits. Axial variations are of less importance as wafers can be selected and cut where the dopant level is appropriate, but if the radial homogeneity is bad the material is useless. Therefore, it is important to investigate thoroughly all contributions to radial segregation in order to optimize the growth conditions of the semiconductor material.

In this experiment the influence of weak convection, caused by surface tension forces on radial dopant segregation is studied under microgravity conditions in seven mirror furnaces. The method used is the floating zone technique, and antimony has been chosen as sample material. The surface of the cylindrical samples is covered by quartz glass. In the upper part where the sample is molten during the experiment, there are a number of small evenly distributed gaps in the quartz glass thus providing a set of regularly shaped free surfaces. The gradient of the surface tension along these free surfaces drives a weak convection inside the melt. In order to separate the influence of this weak convection on the dopant distribution from the one of diffusion, the spots only cover one quarter of the periphery.

Varying the geometry of the free surfaces between the seven flight samples offers the possibility to obtain different levels of the thermocapillary convection.

Payload Description
In the G-730 payload seven ellipsoidal mirror furnaces are used to heat the samples and to create a floating zone. The heat source is a 340-watt halogen lamp, which is positioned

in one of the two focal points of the mirror furnace. In the other focal point the heating power is concentrated directly to the top of the sample rod.

Seven cylindrical samples of antimony, doped with tin will be processed during the flight. All samples have the same size: diameter 7 mm (.275 inches) and length 32 mm (1.7 inches). Each sample is contained in a pressure tight ampoule of quartz glass, which is mounted to the bottom of the furnace. A thermocouple is mounted in the sample rod and is used for thermal control.

The experiment sequence and furnace processing is controlled by a PC104 computer system with a CPU and a data acquisition board. Signals from sensors and accelerometers are connected to a signal conditioning unit. The halogen lamps in the furnaces are pulse width modulated and controlled via a power switch unit.
The payload is powered from two 44 volt batteries of sealed lead-acid cells with a nominal capacity of 1060 watts. During the experiment phase measured experiment data, house-keeping data and data from accelerometers are stored in a non-volatile memory.

Principal Investigator: Professor Dr Torbjorn Carlberg, Mid Sweden University
Experiment system design and manufacturing: Swedish Space Corporation's Space Systems Division under contract from the European Space Agency (ESA) and the Swedish National Space Board (SNSB).

For more information, contact Mr Per Holm, Project Manager, Swedish Space Corporation, e-mail: per.holm@ssc.se , tel +46 8 627 63 03.

For more information on the Swedish Space Corporation see http://www.ssc.se.
For more information on ESA, see http://www.esa.int.
For more information on SNSB, see http://www.snsb.se.
For more information on Mid Sweden University, see http://www.mh.se

G-064

Penn State University
The education and training of engineers in a modern university setting necessarily involves much attention to textbook fundamentals. However, major lessons need to be learned from "hands-on" design and fabrication of hardware in an environment where teamwork and project management skills are learned. The GAS project has provided an opportunity for about 50 Penn State University students to experience these lessons. The experiments are design and fabricated by students working as volunteers, part of the course credit Introduction to Space Physics or as an independent study. Three experiments have been prepared which investigate plant growth in space, the magnetic field environment in the shuttle, and the acoustic signature for collisions on the shuttle by space debris. Support for this project also is provided by Lockheed Martin Corp.

1. The goal of "PSU Germinator I" is to construct and fly a low cost and reusable experimental plant growth chamber capable of providing a 1-g force control

environment as microgravity environment for seed germination and early seedling development; record root growth direction and germination processes with several digital photos each hour for seven days; and answer questions related to sustained plant life in space and provide an affordable space rated test chamber for microgravity and life science researchers.

2. The “Magnetometer” will record a three dimensional model of magnetic moment of the Space shuttle and measure distortions of the uniform background signal from currents that produce a part the Earth’s magnetic field. The experiment will be activated at 50,000 feet during ascent of the Shuttle and collect data for five hours.
3. The “Orbital Debris Experiment will measure the acoustical signature fro hits on the shuttle by micro-meteors or space junk to test a concept for a future space station monitoring sensor. The experiment will operate for seven days.

G-785

NASA Ames Research Center

Payload G-785 is the re-flight of the G-197 payload (STS – 90, April 1998). The primary objective of the experiment is to determine zero-g performance of a miniature two-stage pulse tube cryocooler, a small refrigerator that uses oscillating gaseous helium to achieve a very cold temperature (-315°F, or -193°C) without using cold moving parts. A secondary objective is to measure the thermal conductance of the cryocooler stages (the cold head) over a wide temperature range in zero-g. A third objective is to demonstrate the launch survivability and performance of a cryocooler that uses mostly commercial components. In the previous flight the last two objectives were largely achieved and have been reported. However, the primary objective was not fully achieved due to low voltage on some of the batteries that supply power to the small compressor that produces the oscillating helium in the cold head. The re-flight payload incorporates a significantly improved battery system.

Miniature cryocoolers are required to cool infra-red (IR) sensors in space-based instruments such as imagers and spectrometers. Remote IR sensing is used to measure the temperature and chemical composition of the earth’s surface and atmosphere.

G-785 was developed as a collaboration between Lockheed Martin Corporation (LMC), Denver, CO; the National Institute of Standards and Technology (NIST), Boulder, CO: and NASA Ames Research Center (ARC), Moffett Field, CA.

Primary and co-investigators: Dr. Peter Kittel (ARC),
Dr. Daniel Ladner (LMC),
Dr. Ray Radebaugh (NIST).

Space Experiment Module (SEM) (3)

The Space Experiment Module is a self-contained assembly of structure, power, command and data storage capabilities for micro gravity experiments. SEM is free for U.S. students in grades K-12 and university level. Through an international agreement, students from other countries are participating in SEM flights on STS-108. Selected student experiments are flown in NASA provided modules. The SEM carrier accommodates ten modules in a standard Get Away Special canister. Experiments can be passive (no power requirements) or active (power required). There are three SEM carriers on STS-108. SEM-11 represents the first active SEM since STS-95 in 1998. SEM-11 and the passive SEM-15 are located on the MACH-1 bridge. SEM-12, another passive carrier, is located on the LMC. STS-108 will mark the 5th anniversary of SEM-01, flown on STS-80 in November 1996.

Space Experiment Module web site: http://www.wff.nasa.gov/sem

SEM-11 (Active)

SEM 11 is an international module with experiments from the United States, Argentina, Portugal and Morocco. The module includes both active and passive experiments. It also includes winning entrees from the 2000 and 2001 NASA Student Involvement Program.

RESUME (Restrain Release Using Melting-Wire Experiment) (Active)
Universidad Tecnológica Nacional, Argentina
The goal of RESUME is to perform design, analysis test and flight qualification of a multipurpose original restrain-release mechanism for fastening deployable systems in spacecrafts. The mechanism obtained, based on a melting wire triggered system, has some interesting advantages regarding the classical approaches. RESUME is being flown through and agreement between NASA and the Argentine National Space Agency.

ARIA-3 (Passive)
Washington University, St. Louis, Missouri
The Aria-3 project is a joint Australian/US K-12 education project that will carry 22 selected experiments into space. The focus is on the effects of space on Australian Flora/Fauna. The general approach is a set of "fly and compare" experiments. Schools in Australian will select local flora/fauna that meet the long-duration storage requirement of the SEM program, prepare two samples, keep one on the ground, and fly the second one in space. Once the flight experiments are returned to earth, students will compare the flight and earth samples to detect differences. The Aria-3 involves schools in Australia teamed with schools in the United States. The Australian schools take the lead with the selection of experiments. Then they work via email with a "sister" school in the Missouri. The teams work together to describe the experiments, develop hypothesis, prepare the experiments, package the experiments, and analysis results. Participating schools will fly their own identified experiments. However, the one-to-one linkage with a school in another hemisphere allows the students to collaborate on the preparation and

analysis, as well as learn about students in another country. This international cooperative approach mirrors many science and space engineering projects of today.

"Effect of Weightlessness on the Developmental Cycle in Gypsy Moth" (Passive)
Mohamed V University, Morocco
This experiment will include several batches of gypsy moth eggs, in a state of diapause, in order to study the effects of weightlessness on development. The eggs were collected this June 2001, and should be maintained in an aerated container throughout the experiment. Upon their return to Earth, development will be compared to that of control eggs maintained in the laboratory as measured by the degree of absorption of the extra-embryonic yolk, time to hatching, and survival rate. Histological organ data will also be compared. Additionally we may, in collaboration with partner laboratories in the US, assay ecdysteroids and neurosecretions involved in development.

"PULS★R – Portugal – Unified Learning through Space & Research" (Passive)
Ciência Viva - National Agency for Scientific and Technological Culture, Portugal
The experiments include testing for possible modifications in the seeds of plants, including some Portuguese endemic species and Mediterranean species. Other proposed experiments aim to test valuable products obtained from plants common in Portugal, including typical products like Porto and Madeira wine. Another group refers to experiments connected with science curricula at school or permitting some motivating extensions in the areas of Physics and Material Science.

Collaborative International SEM (Passive)
GADGET - Glenbrook North High School, Northbrook, Illinois
This experiment is part of a collaborative international SEM project. Students from the U.S., Portugal, Morocco and possibly other countries will be involved in the scientific investigation. The experiments will investigate the effects of the space environment on different types of seeds. Other proposed experiments aim to test valuable products obtained from plants common in Portugal and the U.S., including typical products like wine. Other experiments are connected with science curricula at school permitting some motivating extensions in the areas of physics and material science.

"CRISTANAR" (Active)
Argentina
CRISTANAR's main objective is studying the micro gravity effect on the growth and electro optical properties of KDP crystals (potassium dihydrogen phosphate, KH_2PO_4). The morphology and electro optic coefficient of the microgravity grown crystals will then be compared with crystals grown on the Earth during a same period of time, with the same thermal process and experimental system. The crystal growth is realized by the method of super saturation of an aqueous solution by temperature decrease. Crystals of appropriate optic quality and dimensions up to 140 mm x 30 mm x 30 mm have been obtained. In orbit, a thermal cycle subjects the crystal to a partial dissolution in a short

time, in such a way that keeps a seed in a saturated solution at a higher temperature than the initial one. Then a crystal growth is carried out during the flight, using the super saturation method with a slow temperature decrease. After the flight, the crystals remain in thermal equilibrium with the KDP aqueous solution that acts as a means of preservation.

"Three Dimensional Resonance Modes in Microgravity" (Active)
GADGET - NSIP 2000 - Glenbrook North High School, Northbrook, Illinois
This experiment will study how Faraday resonance will affect a wax-like substance suspended in a sodium silicate solution in micro gravity. This will be accomplished by using a tone generated sound system with a speaker attached directly to the acrylic box containing the wax and sodium silicate, and applying a sequence of tones. The results will be video taped for further analysis in both constant and strobe lighting. It is hypothesized that the resonance frequencies will be clearly identifiable for the wax and sodium silicate fundamentals and harmonics. The information gained from this experiment may someday help in understanding the resonance modes of structures made for micro gravity.

"Electro-Deposition of CUSO4" (Active)
NSIP 2000 - The Northwest School, Seattle, Washington
The purpose is to use electrodeposition to determine the effects of micro-gravity and cosmic radiation on the flow of electrons. The experiment will analyze the fractal patterns formed by the deposition of copper when an electric current is passed through a solution of cupric sulfate. Results will help determine how electrical currents flow in the space environment.

"SISTEM" (Passive)
Kingswood Regional Middle School, Wolfeboro, New Hampshire
This experiment was prepared by middle school students from the Technology Student Association chapter at Kingswood Regional Middle School. Located in New Hampshire between Lake Winnipesaukee and the Maine border. The purpose of this experiment is to discover whether the space environment will effect the subsequent generations of various seeds flown in space. It is possible that the space environment will have no effect on the first generation of plants but that a mutation could surface over a number of years. Space and control seeds will be harvested and distributed to more and more participants each growing season for five seasons. This experiment has the potential of including thousands of participants by the end of our fifth year. All data received by participants will be logged onto the KRMS-TSA web site.

"Artemia Space Launch Experiment" (Active)
NSIP 2001 - DuVal High School, Lanham, Maryland
The purpose of the experiment is to see how microgravity affects the rate of hatching, growth, size and mobility of the brine shrimp. If brine shrimp may be used as a food source for fish (astronaut food on ISS or longer manned flights), it is important ensure their life cycle is unaffected by micro gravity. The students from the two ISA classes have constructed an injection device from Legos using a plastic 5 ml syringe and a size

16 needle obtained from a large-animal veterinarian. The syringe will be loaded with approximately 0.5 ml of dehydrated brine shrimp eggs and the needle hole will be plugged with lanolin (to keep the eggs dehydrated); the needle will be inserted into the plastic culture bottle and held in place by a brace until the MEU timing program initiates injection of the eggs into the culture solution. A micro video camera (fixed-focus) will be mounted on the outside of the bottle and a recording unit will take 3 minutes of video every 2 hours, 57 minutes beginning with the injection of the eggs once on orbit. Two micro light bulbs will be mounted in a reflective holder on one of the sides of the culture bottle. A Minco strip foil heater mounted on another side of the culture bottle will maintain the temperature of the saline culture solution at 50-60 degrees F.

SEM-12 (Passive)

"Space FIZ-ics" (Passive)
Athol-Royalston Middle School, Athol, Massachusetts, & Schaumburg High School, Schaumburg, Illinois
This experiment seeks to study the effects of micro gravity, radiation, and temperature fluctuation on the production of carbon dioxide and the growth rate of yeast cells in a closed fermentation chamber. A secondary experiment is to test the ability of a launch activated passive mechanical device to initiate the experiment.

"Blast-Off" (Passive)
Anne Arundel County Schools, Anne Arundel County, Maryland
This experiment is an extension of the 4th grade curriculum Space and Space Technology. The value of the experiment is to see how the space environment will affect materials, and if they would be useful on the International Space Station. There are two schools partnering on this project by sharing the module. The effect of space travel on dental gum will be investigated to determine the feasibility of using it to replace brushing teeth in space. The second experiment will determine the effect of the space environment on *tardigrades*, and how they will behave when reconstituted after space flight.

"A Study on the Role of Adhesives in Entombed Hybrid Patches" (Passive)
Old Dominion University, Norfolk, Virginia
This experiment tests an advanced repair concept for future applications with damaged space structures. The repair patch uses weld bonding which is an advanced hybrid technology that has the advantages of laser welding and adhesive bonding combined. Tensile specimens, fabricated using weld bonding technology, are used to simulate Entombed Hybrid patches which have the capability to restrain crack growth in damages substrates by two separate mechanisms. In the first mode of damage restraint, an entombed composite insert bonded to the metal substrate limits crack growth by providing adhesive shear to prevent cracks from opening. In the second mode, a metal cover provides load transfer to reduces stresses in the vicinity of the damage. Since both the metal cover and the composite insert operate on the same damaged area, the metal cover is designed to entomb the insert.

As in weld-bonded joints, both the weld and the adhesive layer contribute to joint strength and the mechanical behavior of entombed hybrid patches. The load bearing capability of the two constituents and the stress distribution in the damaged substrate are influenced by such factors as the extent of damage and the mechanical properties of the adhesive and the metal substrate. In this experiment, the effects of microgravity on the mechanical properties of adhesive layers entombed under the cover plate will be determined. The mechanical properties of laboratory specimens will be compared to those flown in microgravity. In addition to the experiment on entombed hybrid patches, in a follow-on experiment, third grade students at the Hilton Elementary School in Newport News and the Ghent Elementary School in Norfolk will send corn seeds in space to determine if the space journey affects the growth cycle of the seeds.

"The effect of the space environment on shape memory alloy" (Passive)
The Harker School, San Jose, California
Nitinol is a material which exhibits shape memory properties. Under normal earth gravitational conditions, devices composed of Nitinol, which are deformed in the martensitic state, will revert to their original shape in the austenitic state upon being heated to the critical temperature. The purpose of this investigation is to determine whether devices composed of Nitinol, which are deformed in flight will be capable of being restored to their original condition when heated to the critical temperature upon return to normal Earth gravitation, after being maintained in microgravity.

"Medium Movement" (Passive)
Mechanicsburg School District, Mechanicsburg, Pennsylvania
It is hypothesize that during the shuttle mission; there will be some movement of ½ inch diameter "Quality Natural Wood Products" spheres INTO 8 different media. The amount of movement is dependent upon the type of medium. Seven ½ cup Rubbermaid containers will have three wooden spheres on the "bottom". Different medium (balsa wood, cork, caulking material, play-dough, potting soil, pink fiberglass insulation, talcum powder, or Styrofoam insulation) will also be placed in each container. Three additional wooden spheres will be placed on the "top" of the medium and then the Rubbermaid lid will complete the assembly. An identical control experiment will remain here at our school. Students will use measurements of mass (grams) and volume (cubic centimeters) to calculate the density of each individual medium. We will measure the mass of each wooden sphere (6 per container X 8 = 48 spheres) to eliminate any non-conforming spheres. Placement of the wooden spheres will be as per a clock face from "12", "clock's center", "6". Spheres will be marked with a small "T" for top spheres and "B" for the bottom spheres. This will help determine any movement after the mission is completed. The group will be a mixture of students from the Mechanicsburg Area Intermediate School. (M.A.I.S.) With time as a premium, selected students from the Gifted Program (grade 8), Science Olympiad Team (grades 6,7,8), Rocket-Satellite Club (grades 6,7,8), and the 8th grade Physical Science Classes will participate in this experiment.

"The Florida-Mars Connection" (Passive)
Palm Beach County Middle Schools, Boyton Beach, Florida
The Florida/Mars Connection Team intends to join farmers and scientists from around the globe as they attempt to find food substances that can grow in natural Martian Soil. On the day that students in the Space Farmers Club plant a variety of seeds, including soybeans, in simulated Martian Soil, in hydroponics grow pots, they will also prepare vials with soybeans and Martian Soil to be stored aboard a shuttle for a ride among the stars. One vial will contain soybeans without soil as a control. The SEM Project will test the null hypothesis: Soybeans planted in simulated Martian Soil will not grow naturally when exposed to radiation, extreme temperatures, and micro gravity.

"Sprouting Seeds" (Passive)
Creekside Intermediate School, Leadue City, Texas
The experiment team will investigate the effect of the space environment on sprouting seeds. A passive watering system will also be tested that will be activated by the launch environment.

"Neurospora cresse on Bread in Space" (Passive)
Cranston High School, Cranston, Rhode Island
The purpose of the experiment is to see how the space environment will effect Neurospora cresse on bread. Different types of bread will be investigated in the experiment. As people begin to live in space, it becomes increasingly important to determine how the space environment will affect harmful organisms that may affect our food.

"SEM Endeavour Program" (Passive)
Pennsylvania Middle Schools, Archbald, Pennsylvania
Experiment participants are from Pennsylvania middle schools who have participated in the NASA Endeavour program for the past two years. Adhesives, plant seeds, tree seeds, spores, and bacterial samples will be tested to find the effects from space flight. All schools involved will share this module.

"Space Soy, Generation GappED" (Passive)
New Oxford Elementary School and Brethren Home Retirement Community, Hanover, Pennsylvania
New Oxford Elementary School will partner with the retirement community in this project. Students will make use of the Greenhouse facility at the retirement community, and will work with the senior citizens on all aspects of the project. The investigation will determine how Soy will grow after the seeds have been subjected to the space environment on a Shuttle flight.

SEM-15 (Passive)

"Invertabraes in Microgravity" (Passive)
NORSTAR, Norfolk, Virginia
The experiment will test the effects of micro gravity on Edith's Checkerspot Butterflies. Butterfly eggs will be sent in a state of diapause, so there are no time limitations. After flight the butterflies will be observed to see if they can still pollinate flowers, reproduce, and perform everyday functions. The Edith's Checkerspot Butterflies were chosen because they live in high mountain ranges, as well as coastal regions, and are known to be able to withstand both extreme cold and heat. As a secondary project, with the purpose of retesting a previous experiment, artemia eggs in diapause will also be flown.

"MEDLAB" (Passive)
Guardian Lutheran School, Dearborn Heights, Michigan
The purpose of the experiment is to study the effects on animal tissue in space. By studying animal tissues, the students will hopefully gain insight as to the effects of space travel on mankind, as well as his traditional food sources. Will humans be able to have alternatives to vegetarian and/or preserved earth foods? Based on the success of the experiment, we also hope to gain insight on possible preservation techniques.

"Magnetic Stars" (Passive)
Henry E. Harris School, Bayonne, New Jersey
The purpose of our experiment is to learn how magnets react during space travel. Student teams will construct structures using magnetic star/moon shapes. Drawings will be made on graph paper and photographs will be taken and labeled to record each structure. One structure will be packed for launch and the other five will have one variable added to each (suspended upside-down, submerged in water, placed into a freezer, placed sideways, etc.). When the structure returns from space, all six will be compared and measured to detect any movement in the structure.

"Magnets and the Magnetosphere" (Passive)
Woodland Middle School, East Meadow, New York
The purpose of the experiment is to study how the shuttle's passage through the Earth's magnetic field lines affects magnetic items. Magnets, security strips, nails, lodestone, and magnetic marbles are the primary objects under investigation. The experiment is a follow up investigation on a previous SEM project that follows the idea that in science "every answer generates additional questions". The experiment also encourages students to develop skills for comparison and contrast.

"Folger McKinsey Space Owls" (Passive)
Folger McKinsey Elementary, Severna Park, Maryland
Students from Folger McKinsey Elementary School will study the effects of the space environment of a variety of materials. Several student teams will share the available volume of the module. Flight materials will include balloons, electronic components,

magnets, detergents, oils, sponges, rubber bands, and various fluids for PH testing. Students will determine how radiation, temperature, and microgravity of the space environment will affect these materials.

"Aria-4: Space, Man, and Biology" (Passive)
Washington University, St. Louis, Missouri
The Aria-4 project is a St. Louis education project involving the effects of space on biology. The project involves students from the Central Institute for the Deaf and the Good Hope School in partnership with the Washington University's School of Engineering and Applied Science. The project will carry 22 "fly and compare" experiments involving biological samples such as vegetable seeds, flower seeds, yeast, brine shrimp, pond water samples, and human hair samples. The schools have selected biological samples that meet the long-duration storage requirement of the SEM program. The will prepare two samples, keep one on the ground, and fly the second one in space. Once the flight experiments are returned to earth, students will compare the flight and earth samples to detect differences.

"Soothing, Minty, and Fresh on ISS" (Passive)
Broadneck Elementary, Arnold, Maryland
This experiment is an extension of the 4th grade curriculum Space and Space Technology. The purpose of the experiment is to see how everyday materials will be affected by the space environment, and if they would be useful on the International Space Station. Several student teams from Broadneck Elementary will be partnering in this investigation. Experiment materials will include dental gum, elastic, cough drops, and air freshener material.

"The effects of environmental conditions on soil and water" (Passive)
Northeastern Pennsylvania GLOBE Project
The experiment conducted will test the effects of micro gravity, radiation, and magnetism on samples of soil and water from throughout northeastern Pennsylvania. Characteristics tested will include Ph, electric conductivity, nitrates, and NPK. These characteristics will then be compared to those materials that flew aboard the space shuttle. Consideration will be given as to how these effects would enhance the growth of seeds that were nurtured utilizing this soil and water. As more humans continue the journey into space, it will be important to consider the ramifications of such an environment. This experiment provides students with such an opportunity, as well as an opportunity to look more into their own environment and compare the differences.

"From Anthracite to Space Flight" (Passive)
Forest City Regional, Hazleton Area, Riverside, Scranton School Districts and Northeastern Educational Intermediate Unit 19, Northeastern Pennsylvania
The experiment will allow students to measure the effects of microgravity, radiation, extreme temperature changes, and intense vibration on both physical and chemical properties of various materials related to anthracite. It is hypothesize that the conditions encountered in space travel will alter the physical and chemical properties of mixtures and pure substances. The investigation will be integrated into classroom and will be

correlated with the Pennsylvania Standards in Science and Technology. Students will measure changes in appearance, density, conductivity, magnetism, strength, malleability, ductility, heat capacity, reactivity, and solubility.

"Countdown to Wildflowers" (Passive)
TODTWD 2001, Eastern Shore, Virginia
The NASA Goddard Wallops Flight Facility's Women of Wallops Federal Women's Program co-sponsored the annual Take Our Daughters to Work Day (TODTWD) activity on Thursday, April 26, 2001. The event was co-sponsored by NASA, Navy and NOAA at Wallops Island, Va. Among the day's activities, students toured the SEM integration facility and prepared vials of wildflower seeds for a SEM opportunity. The purpose of this experiment is to determine the effects of microgravity and space travel on wildflower seeds. Students also are keeping a control group on Earth. After the return of the Space Shuttle, both sets of seeds will then be planted to compare their germination rates, as well as compare their plants, flowers, and seeds. The experiment may be de-integrated as an activity for TODWTD 2002.
The above group will be partnering with Fulton Elementary, Howard County Public School System, Howard County, Md., by sharing the available volume of the module. This secondary experiment will consist of vegetable seeds, flower seeds, brine shrimp, and a yeast sample.